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Electron rest mass and energy levels of atoms in the photonic crystal medium

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Abstract

Photonic crystals are periodic systems that consist of dielectrics with different refractive indices. They are designed to act on photons in contrast to semiconductor crystals whose periodicity affects the motion of electrons. Here we consider the interaction of an atomic electron with its own radiation field in the case when the atom is placed in air voids of a photonic crystal and is not in mechanical contact with the vibrational degrees of freedom of the dielectric host. A strong modification of this interaction from that in free space is shown to change the rest mass of the electron, and this has a significant effect on the shift of the atomic energy levels. This shift is investigated by using the example of atomic hydrogen in a high-index-contrast photonic crystal. The found effect may be of interest both from fundamental and practical points of view. © 2012 American Physical Society.

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